ABDOMINAL EXERCISER WITH ELECTRONIC COACHING DEVICE

FIELD OF THE INVENTION

[0001] The present invention relates generally to a home exercise device. In particular, the present invention relates to a device for providing personal exercise instruction and coaching to a user of abdominal isometric exercise methods and equipment.

BACKGROUND OF THE INVENTION

[0002] Physical exercise generally improves health and physical conditioning. The benefits of regular physical activity can be obtained through several types of exercise. Each type of exercise includes at least one of the four muscular phases. These muscular phases are isokinetic, isometric, concentric, and eccentric. The isokinetic muscular phase is achieved through quick repetitive motion, while the isometric muscular phase is achieved through the tightening and holding of these tightened muscles. The concentric muscular phase is achieved through the slow contraction of muscles, while the eccentric muscular phase is achieved through the slow relaxation of the muscles under a load.

[0003] Exercise that use the isometric muscular phase (hereinafter referred to as "isometric exercise") are effective for developing strength in a specific muscle or group of muscles. Isometric exercises may be used for rehabilitation because of the ability to isolate the exact area of muscle weakness. Additionally, this type of exercise can provide a fairly quick and convenient method for overloading and strengthening muscles with slight chance of injury and without the need for special equipment.

[0004] The efficient development of the abdominal muscles of the human body is particularly difficult. Because the abdominal muscles are not attached to any joint, traditional joint movement exercises are ineffective. Exercises such as sit-ups or weight-loaded variations on sit-ups may indirectly involve the abdominal muscles, but are inefficient because much exercise energy is dissipated in the joints and muscles attached to the joints, such as hip flexors. The use of isometric exercises on the abdominal region has the result of isolating the abdominal muscles, thereby allowing the proper muscles to be overloaded and strengthened.

[0005] However, for any isometric exercise to yield the proper results, it must be performed properly. The exercise must focus on the proper muscle and the proper muscle must be contracted, held contracted and relaxed for the proper time intervals. If the exercise is performed on the wrong muscle group, the targeted group will receive no overloading, and thus will not strengthen. If the exercise is performed on the correct muscle group, but for incorrect time intervals, the targeted muscle group will not undergo the proper overloading required to strengthen.

[0006] The majority of people who exercise are unaware of the proper methods of isometric exercise. During the exertion of exercising, even those who are aware of the proper method and timing often fail to follow it. Thus, there is a need for instruction with regard to the performance of isometric exercises, particularly there is a need for instruction as to how long to contract the muscles, hold the muscles in a contracted state, and relax the muscles.

[0007] Additionally, during any exercise routine, the user often has a need for motivation and encouragement. As with any exercise, the exertions of each movement gradually become more and more difficult, typically causing the user to need motivation or encouragement to finish. It is generally accepted that the majority of muscle overloading and growth happens in

the last few repetitions of an exercise, and these are typically the repetitions that, without motivation or encouragement, the user will forego. Since the movement and actions are the same for each exercise repetition, the user may also become bored, and may therefore need motivation or encouragement to finish the proper number of repetitions while performing them correctly.

[0008] This need for motivation or encouragement is often solved by users joining a fitness club or gymnasium. Fitness clubs and gymnasiums often offer what are known as "personal trainers," who offer exercise instruction as well as motivation and encouragement. However, there are several drawbacks to personal trainers, as well as fitness clubs and gymnasiums. First, joining a fitness club or gymnasium generally costs a significant amount of money. Obtaining the instruction and motivation of a personal trainer can often cost the user even more. Second, the time required to go to a fitness club or gymnasium and exercise often exceeds the time available to people to exercise. Third, having to travel to a different area in order to exercise can be quite inconvenient, depending on the location of the fitness club or gymnasium.

[0009] Some of these drawbacks are solved by using home exercise equipment. Such home equipment may be relatively inexpensive, and the user can exercise when he or she has time and when it is convenient. However, the majority of home exercise products do not offer the user the instruction or motivation that can be found at a fitness club or gymnasium. Such home exercise equipment may include instructional videos or digital video discs, but such aids are inconvenient in that they are separate from the exercise device. This separation often leads to the user foregoing use of the instructional video or digital video disc.

[0010] In view of the foregoing, there is a need for a home abdominal isometric exercise device that has a component which provides active instruction and motivation to the user. There is also a need for such an exercise instruction component that visually and/or audibly guides the user through different multiple muscular phases of an exercise.

SUMMARY OF THE INVENTION

[0011] Responsive to the forgoing challenges, Applicant has developed an innovative device and method for electronically coaching a user of an exercise apparatus that a user operates to perform an exercise activity having multiple muscular phases. The method generally comprises: determining that the exercise activity should be performed according to a first muscular phase; providing a user perceptible output to prompt the user to operate the exercise device according to the first muscular phase; determining that the exercise activity should be performed according to a second muscular phase that differs from the first muscular phase; and providing a second user perceptible output different from the first user perceptible output, to prompt the user to operate the exercise device according to the second muscular phase. In alternative embodiments, the method may further comprise determining that the exercise activity should be performed according to a third muscular phase that differs from the first and second muscular phases, and providing a third user perceptible output that different from the first and second perceptible outputs, to prompt the user to operate the exercise device according to the third muscular phase.

[0012] The instructional device, which can be referred to as an "electronic coach," may be programmed to instruct users as to the optimal way to perform multiple muscular phase

abdominal exercises, as well as provide motivation during the exercise. The electronic coach includes a visual display and an audio output. The audio output may be used to produce pre-recorded words or sentences in order to instruct and motivate the user. The visual display provides a user interface that guides the user through the exercise. In one embodiment, the user interface includes a plurality of lights, in order to visually instruct the user of the proper amount of time for each portion of an exercise. The user interface may also allow a user to select various exercise routines and levels, as well as allow the exercise routine to be paused or cancelled.

[0013] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only, and are not restrictive of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] In order to assist in the understanding of the invention, reference will now be made to the appended drawings, in which like reference characters refer to like elements. The drawings are exemplary only, and should not be construed as limiting the invention.

[0015] **FIG. 1A** is a perspective view of an exercise device including an electronic coach device in accordance with the present invention.

[0016] **FIG. 1B** is a cross-sectional view of the exercise device of **FIG. 1A**.

[0017] **FIG. 2** is a plane view of an embodiment of an electronic coach device in accordance with the present invention.

[0018] **FIG. 3** is a detail view of a locking device to attach the electronic coach device to an exercise device according to an embodiment of the present invention.

[0019] **FIG. 4** is a perspective view of an embodiment of an exercise device with an electronic coach device mounted thereon in accordance with the present invention.

[0020] **FIG. 5** is a block diagram illustrating an embodiment of an electronic coach device in accordance with the present invention.

[0021] **FIG. 6** is a flow diagram illustrating an embodiment of an electronic coaching functionality in accordance with the present invention.

[0022] **FIG. 7** is a perspective view of another embodiment of an electronic coach device and exercise device with a magnetic proximity sensor system.

DETAILED DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION

[0023] Reference will now be made in detail to a first embodiment of the present invention, an example of which is illustrated in the accompanying drawings.

[0024] FIG. 1A depicts an exercise apparatus **20** that electronic coach **10** may be used with in accordance one embodiment of the present invention. The exercise apparatus comprises a generally rectangular body **22** forming a yoke that connects a pair of handles **24** and **26**. The handles are positioned on opposing locations of the yoke and extend away from the yoke at angles with the X axis and Y axis. A slide member **30** is slidably held in a channel **28** that extends through the center of the yoke in a direction perpendicular to the X axis. The slide reciprocates back and forth in a longitudinal direction in the channel. A base **32** is detachably connected at a user engagement end **34** of the slide. The user engagement end extends out of the channel to engage a targeted muscle area. The base has a user engagement surface **36**, which is sized to provide a large contact area with a user's body to increase stability and reduce the

pressure in the contact area. The engagement surface may also be provided with a foam pad to cushion the contact area.

[0025] FIG. 1B is a cross sectional view of the exercise apparatus. As indicated, the opposite end of slide **30** is a resilient member engagement end **40**, that engages a median portion of a resilient member, such as an elastic cord **42**. The extremities **44** and **46** of elastic cord **42** each have an aperture **86** attached to one of a pair of anchoring posts **48** and **50** that extend from the undersurface of the yoke on opposite sides of channel **28** and slide **30**. The middle of elastic cord **42** wraps around the resilient member engagement end **40**. This results in the elastic cord **42** engaging both the body and slide to bias the slide toward the user. As the slide progresses into the channel away from the user, it stretches the elastic cord **42** which resiliently opposes the movement.

[0026] The yoke and handle assembly **22** is formed as an integral piece of plastic including a bottom plate **68** and side walls **70**, that form the channel **28** to engage and guide the movement of the slide. The body comprises two opposing sides and the channel is located between the sides. Each handle is attached to only one side and is opposite the other handle. Reinforcing ribs **72** are utilized throughout the body and the handles to ensure adequate strength and rigidity. Each of the two handles **24** and **26** mark the end of wrist receiving areas **60** and **62**, which are bridged by arcuate wrist support strips **64** and **66**. These wrist support strips support the wrists of the user, providing comfort and safety while additionally providing strength and stability to the apparatus.

[0027] The handles extend from the X axis at equal angles, with the magnitude and direction of the angles selected such that the user's arms are placed in a natural position while exercising to increase stability. With the handles angled, the user's elbows rest comfortably in a

natural position besides the torso. To add further stability, the handles extend at least as high, and preferably above, the top of the body of the device.

[0028] The slide member includes at least one rectangular cavity **56** centrally positioned in a lateral direction. The rectangular cavity **56** may be disposed so as to receive a rectangular extrusion **145** on the electronic coach **10**. As seen in FIG. 3, the rectangular extrusion **145** includes a biased locking device **147**, that prevents the electronic coach **10** from sliding out of the exercise device **20**. When the extrusion **145** is inserted into the rectangular cavity **56** on the slide, the user will be able to clearly see and hear the electronic coach throughout the exercise routine. This can be seen in FIG. 4, which depicts an electronic coach **10** mounted on an exercise device **20** according to one embodiment of the present invention.

[0029] The exercise apparatus **20** may be used to develop abdominal muscles. A user assumes a seated position with forelegs substantially vertical. While keeping the spine in the erect position, the user holds the exercise apparatus **20** by the pair of handles **24** and **26** with the palms up. The user places the base **32** against the abdomen. The user then pulls the handles **24** and **26** towards the abdomen while tightening the abdominal muscles and crunching, causing the slide **30** to move to move through the immobilized yoke **22**. This portion of the exercise is termed the concentric portion. When the abdominal muscles are in a fully tightened position and the user has forced the slide **30** as far as possible, the position is held. This portion of the exercise is termed the isometric portion. The user then slowly relaxes the abdominal muscles, allowing the slide **30** to gradually return to its starting position. This portion of the exercise is termed the eccentric portion.

[0030] The electronic coach **10** aids the user in accomplishing this multiple muscular phase exercise activity by determining that a first muscular phase, the concentric phase, should

be performed, and providing a user perceptible output that prompts and instructs the user how to properly perform this phase. The electronic coach **10** then determines that a second muscular phase, the isometric phase, should be performed and provides a second user perceptible output that is different than the first, that prompts and instructs the user how to properly perform this phase. The electronic coach **10** may then determine that a third muscular phase, the eccentric phase, should be performed and will then provide a third user perceptible output that is different than the first and second that prompts and instructs the user how to properly perform this phase. The electronic coach **10** instructs the user through both visual and audio outputs as to the proper timing and method of performing each phase of the exercise activity.

[0031] FIG. 2 illustrates an electronic coach device **10** in more detail. The electronic coach device **10** includes a power switch **111,** a volume control **112**, and at least one button. The at least one button may be of a type commonly known in the art, and may include buttons corresponding to an introduction **113**, various exercise levels and routines **114** and **115**, as well as a start **116**, a pause **117**, and a cancel **118** button.

[0032] The electronic coach device **10** provides audio and visual outputs that guide the user of the exercise apparatus through the exercise. Speaker **119** may be located in the upper left corner of the electronic coach **10** and is of a type well known in the art. The speaker **119** outputs verbal commands and sounds at the appropriate times to instruct the user through the multiple phases of the exercise.

[0033] A plurality of lights **311** are arranged such that they form a graphical representation to the user of the proper timing for each exercise in the routine. In one embodiment of the present invention, the lights **311** are arranged in an arc **320** including a first segment **321** and a second segment **322** separated by an apex location **333**. The lights in the first

segment **321** of the arc may represent the concentric portion of the exercise, a single light in the apex location **323** may represent the isometric portion of the exercise, and lights in the second segment **322** of the arc represent the eccentric portion of the exercise. Additionally, the concentric lights in the first segment **321** may be of one color, the isometric light at the apex location **323** of another color, and the eccentric lights in the second segment **322** of a third color. In a preferred embodiment of the present invention, the lights in the first segment **321** will light in a consecutive cascading sequence to illustrate the concentric portion. These lights will then turn off when the concentric phase is complete, and then the single light at the apex location **323** illustrating the isometric portion is lit. This light will turn off when the isometric phase is complete, and the lights in the second segment **322** representing the eccentric portion are lit in a consecutive cascading sequence.

[0034] The display screen **350** is a conventional liquid crystal display (LCD). The display screen **350** is partitioned into three sections **351**, **352**, and **353** respectively, that display to the user the number of repetitions performed, the number of sets performed, and the amount of time that has elapsed during the exercise routine, respectively. The display is made using conventional numeric characters.

[0035] Although the lights **311** and display screen **350** are respectively shown to implement LEDs and an LCD display, various alternatives may be provided. For example, an LCD display may be used to provide the visual features of both the lights **311** and the display screen **350**. Alternatively, LEDs, LCDs, or any other display type may be used for all or part of the visual features of the electronic coach **10**.

[0036] The electronic coach **10** functions as follows. When the power switch **111** is turned to an "On" position, the user will be greeted by the Welcome track and instructed to press

the "Start" button **116**. When the "Start" button **116** is pressed, the electronic coach **10** may give the user the option of either pressing the "Introduction" button **113** or starting an exercise routine. If the "Introduction" button **113** is pressed, the electronic coach **10** will instruct the user on how to correctly perform the exercise, as well as how to use the electronic coach **10** and read the visual output device **504** by playing the Introduction track.

[0037] After the introduction is given, or if the user decides to skip the introduction, the user is instructed to select an exercise routine. Such routines may include a "Beginner" or an "Intermediate-Advanced" routine. When the user selects either of these routines **114** and **115** respectively, the electronic coach **10** will instruct the user when to pull the handles **24** and **26** (for the concentric phase of the abdominal exercise), when to hold the muscles in a contracted position (the isometric phase), and when to release them. It also visually and audibly guides the user to perform each phase of the exercise for the appropriate amount of time, the appropriate number of repetitions, and the appropriate number of sets of repetitions.

[0038] The block diagram of FIG. 5 illustrates an embodiment of an electronic coach **100** to include a user input interface **502**, visual output interface **504**, audible output interface **506**, processor **508**, and memory **510**. The user input interface **502** receives user input through the above described buttons. The visual output interface **504** connects to and provides appropriate signals to the visual displays provided by the electronic coach **100**, such as provided via the above described lights and LCD display. The audible output interface **506** connects to and provides appropriate signals to the audio output device (e.g. speakers) of the electronic coach **10**.

[0039] The electronic coach **10** is arranged to respond to user input and provide appropriate output according to instructions that are stored in a memory **510** and executed by a processor **508**. More specifically, the memory **510** includes an electronic coaching module **512**

for providing these instructions and the corresponding functionality. The electronic coaching module **512** is preferably provided as software, but can alternatively be provided as hardware or firmware, or any combination of software, hardware and firmware.

[0040] The electronic coaching module **512** further includes a configuration settings module **514**, a phase determination module **516**, a visual coaching module **518**, and an audio coaching module **520**. The configuration settings module **514** communicates with the user input interface **502**. It determines and retains the type of user input received ("Introduction", "Beginner", "Intermediate Advanced" etc.), and also provides corresponding basic functionality such as presentation of the introduction sequence where such is requested.

[0041] The phase determination module **516** determines whether the exercise activity should be performed according to one or more particular muscular phases (e.g., concentric, isometric and eccentric). It also communicates such determined phases to the visual coaching module **518** and the audio coaching module **520**, which causes them to provide particular visual and audio outputs that are intended to instruct and prompt the user to operate the exercise apparatus correctly, according to the determined muscular phases. In one embodiment, the phase determination module **516** implements a timer to determine the commencement and conclusion of the muscular phases. The phase determination module **516** further communicates with the configuration settings module **514** to determine the operational mode, and includes instructions that determine the number of sets and repetitions within each set are to be performed, with appropriate determination of muscular phases during the course of an exercise activity.

[0042] The visual coaching module **518** produces signals that control the display elements of the electronic coach **10** through the visual output interface **504**. In one embodiment, the visual coaching module **518** includes software based instructions that cause the signals to be

produced for an appropriate amount of time (e.g., 2-8 seconds) after initial indication that a particular muscular phase has commenced. Conventional signals for driving the LED and LCD displays may be used to accommodate the driving of the displays.

[0043] The audio coaching module **520** similarly produces signals that control the audio output elements of the electronic coach **10** through the audible output interface **506**. Again, the audio coaching module **520** may include software that causes an audio output to commence and proceed for an appropriate amount of time after indication that a particular muscular phase has commenced. The audio output signals may be stored as .wav files or files in other conventional formats.

[0044] The flow diagram of FIG. 6 illustrates a process **600** for coaching a user of an exercise apparatus, such as performed according to the instructions in the electronic coaching module (**512**). As described, the user selects an operational mode such as "Beginner" or "Intermediate Advanced." Other selections may also be made, includes a three options selection offering "Beginner", "Intermediate", and "Advanced", or various other numbers and types of options.

[0045] In step **602**, the operational mode is determined and then the appropriate number of sets and repetitions are loaded so that the coaching can sequence through the appropriate number of sets and repetitions (typically the same number each set, but alternatively a varying number) to be performed. The number of sets and repetitions are retained in association with variable names such as "SetLimit" and "Replimit." These can of course be arrays, such as where the number of repetitions varies. During the course of the instructions, counters determine the number of sets and repetitions that have been performed (e.g., "SetCount" and "RepCount"). These counters are reset to zero at the commencement of the exercise program. Upon

determination **604** that the number of sets has not been completed (i.e., SetCount is not greater than SetLimit), the count of the number of sets is incremented **604**. Since the number of reps is also initialized, it is determined **608** that the count is under the limit, the rep count is incremented **610**, and then output for the first phase of the exercise is provided **614**. Preferably, the current set and rep numbers are caused to be displayed by the electronic coach in the previously introduced display locations.

[0046] In one embodiment, the first phase of exercise is the concentric phase. Accordingly, visual and audio output signals appropriate for the concentric phase are provided. More specifically, as previously described this display may be the sequential lighting of LEDs along a first arc segment visually corresponding to the concentric phase of the exercise. Similarly, appropriate audio commands are played during this phase, such as "Pull slowly, move your shoulders forward while crunching."

[0047] The concentric phase output is provided **614** until it is determined **616** that the concentric phase has been completed, which is preferably 2-8 seconds after commencement of the phase.

[0048] Upon completion of the concentric phase, output for the isometric phase is commenced **618**. Again, visual and audio output signals appropriate for the isometric phase are provided, such as lighting of an LED at the apex of the arc, and instructions such as "Hold it, and tighten those abs!" This output is provided **618** until it is determined **620** that the isometric phase is completed, which is preferably 2-8 seconds after commencement of the isometric phase.

[0049] The eccentric phase then commences and appropriate output for that phase is provided **622**, until it is determined **624** that it too has been completed, again preferably 2-8 seconds after commencement. Here, lighting of the second arc segment and audio instructions

such as "Now, release slowly and tighten those abs!" are caused to be output to the user through the electronic coaching device.

[0050] The sequence of providing concentric **614**, isometric **616** and eccentric **618** visual and audio outputs continues until it is determined **608** that the number of reps has been completed (RepCount > RepLimit) and it is determined **604** that the last set has been completed (SetCount > SetLimit), upon which the phase based instructions terminate. Output appropriate for the conclusion of the exercise session, such as encouraging and congratulatory words, and other helpful comments, such as daily diet and health advice, can then be provided to the user if desired.

[0051] In an alternative embodiment of the present invention, shown in Fig. 7, the electronic coach **10** may include a magnetic proximity sensor **700** that senses a magnet **750** mounted on the exercise device **20**. In this embodiment, the electronic coach **10** may determine when the routine has begun, as well as the length of time the user takes to accomplish each phase. If the length of time that it takes the user to accomplish each phase does not fall within allowable or preferred limits, the electronic coach **10** may inform the user that the particular phase(s) of the exercise should be sped up or slowed down. Such information may be provided during the course of exercise or by reporting the results after completion. Additionally, the audio and/or visual information may adjust based upon the detection of the amount of time against the preferred range. Thus, for example, audio may instruct the user to speed up or slow down during one or more phases, and video may similarly prompt the same, such as by supplementing the existing visual display or altering the colors of the existing visual display.

[0052] It will be apparent to those skilled in the art that various modifications and variations can be made in the construction, configuration, and/or operation of the present invention without departing from the scope or spirit of the invention.